LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

LLNL-TR-407436

Progress report for FACETS (Framework Application for Core-Edge Transport Simulations): C.S. SAP

T. G. W. Epperly

October 2, 2008

Disclaimer

This document was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor Lawrence Livermore National Security, LLC, nor any of their employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or Lawrence Livermore National Security, LLC. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC, and shall not be used for advertising or product endorsement purposes.

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Progress report for

FACETS (Framework Application for Core-Edge Transport Simulations)

T. G. W. Epperly, C.S. SAP Principal Investigator

Lawrence Livermore National Laboratory (LLNL)

October 15, 2008

(DOE Contract No. DE-AC52-07NA27344; Release No. LLNL-TR-407436)[1]

1. Introduction

The mission of the Computer Science Scientific Application Partnership (C.S. SAP) at LLNL is to develop and apply leading-edge scientific component technology to FACETS software. Contributions from LLNL's fusion energy program staff towards the underlying physics modules are described in a separate report. FACETS uses component technology to combine selectively multiple physics and solver software modules written in different languages by different institutions together in an tightly-integrated, parallel computing framework for Tokamak reactor modeling.

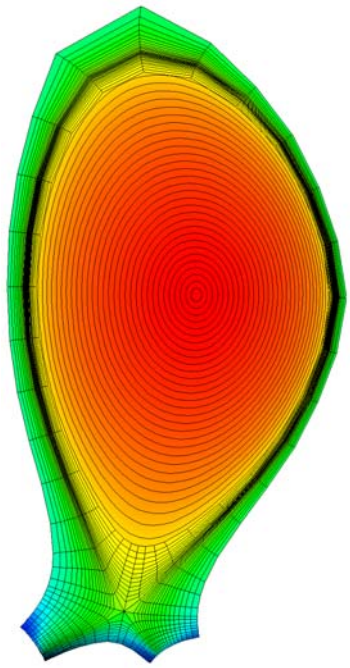

Fig. 1. FACETS uses Babel to combine software components written in multiple languages to produce the first integrated core-edge simulation.

2. C.S. SAP Accomplishments for FY08

In the past fiscal year, the C.S. SAP has focused on two primary tasks: applying Babel to connect UEDGE into the FACETS framework through UEDGE's existing Python interface and developing a next generation componentization strategy for UEDGE which avoids the use of Python. The FACETS project uses Babel to solve its language interoperability challenges. Specific accomplishments for the year include:

- Refined SIDL interfaces for UEDGE to meet satisfy the standard interfaces required by FACETS for all physics modules. This required consensus building between framework and UEDGE developers.
- Wrote prototype C++ driver for UEDGE to demonstrate how UEDGE can be called from C++ using Babel.

[1] This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

- Supported the FACETS project by adding new features to Babel such as release number tagging, porting to new machines, and adding new configuration options. Babel modifications were delivered to FACETS by testing and publishing development snapshots in the projects software repository.
- Assisted Tech-X Corporation in testing and debugging of a high level build system for the complete FACETS tool chain – the complete list of third-party software libraries that FACETS depends on directly or indirectly (e.g., MPI, HDF5, PACT, etc.).
- Designed and implemented a new approach to wrapping UEDGE as a FACETS component without requiring Python. To get simulation results as soon as possible, our initial connection from the FACETS framework to UEDGE uses a Forthon-generated Python layer that sits on top of the UEDGE Fortran code. To run on leadership class machines that do not support shared libraries such as Franklin (NERSCS) and Jaguar (ORNL), FACETS requires a more direct connection to the UEDGE Fortran that eliminates the Python layer. We designed and developed an extension for Forthon to provide a direct connection from C++ to the UEDGE Fortran using Babel. This also required added annotations to the Forthon ".v" input files to indicate how function parameters are used.

3. Publications

J R Cary, J Candy, R H Cohen, S Krasheninnikov, D C McCune, D J Estep, J Larson, A D Malony, A. Pankin, P H Worley, J A Carlsson, A H Hakim, P Hamill, S Kruger, M Miah, S Muzsala, A Pletzer, S Shasharina, D Wade-Stein, N Wang, S. Balay, L McInnes, H Zhang, T Casper, L Diachin, T Epperly, T D Rognlien, M R Fahey, J Cobb, A Morris, S Shende, G W Hammett, K Indireshkumar, D Stotler, A Yu Pigarov, "First results from core-edge parallel composition in the FACETS project," J. Physics: Conf. Series, accepted (2008).

4. Presentations

J. R. Cary for the FACETS Team, "FACETS: Framework Application for Core-Edge Transport Simulations," ITER Integrated Modeling Workshop on Component Interfaces (Cadarache, FRANCE, Sep 2007).